Space Station Radiator Test Hosted by NASA Lewis at Plum Brook Station

In April of 1997, the NASA Lewis Research Center hosted the testing of the photovoltaic thermal radiator that is to be launched in 1999 as part of flight 4A of the International Space Station. The tests were conducted by Lockheed Martin Vought Systems of Dallas, who built the radiator. This radiator, and three more like it, will be used to cool the electronic system and power storage batteries for the space station's solar power system. Three of the four units will also be used early on to cool the service module.

This test involved multiple deployments (extension and retraction) of the 50-ft-long radiator, thermal cycling using infrared lamps as a heat source, and proof of performance-including flowing liquid ammonia through the radiator and viewing it with an infrared imaging system, and taking thermocouple readings. All tests were performed in the Space Power Facility at Lewis' Plum Brook Station facility. The Space Power Facility is the largest vacuum tank in the world: 120 ft in height and 100 ft in diameter. It was outfitted with a Lewis-designed cryogenic enclosure, or cryoshroud, over 22-ft high with a 40- by 78-ft floor area. The cryoshroud used gasified liquid nitrogen to achieve temperatures as low as -250 °F in its interior. In combination, the cryoshroud and tank provided a simulated space environment for these tests. Vacuums in the 10^{-6} torr range and temperatures lower than -230 °F were achieved. Since the radiator is designed to exist in the weightlessness of orbit, it was necessary to support it on a set of rails for these tests, so that deployment in Earth's gravity would not harm it. Also tested was the manual deployment crank, which would be used by an astronaut if the motor system failed.

In addition, under stringent time, money, and safety constraints, Lewis designed and built a remote-controlled ammonia handling system to furnish the large amount of liquid ammonia needed for the test. Most of the handling system was built at Lewis in an enclosure about the size of a medium-sized house trailer. It was shipped to Plum Brook for final integration into the test. Because of safety considerations, this system was

mounted outdoors and was operated entirely by computer control, monitored by television. Liquid ammonia was supplied at controlled temperatures in two separately controlled flow loops.

The series of tests proved the photovoltaic radiator's readiness for its mission, showed compliance with thermal and hydraulic performance requirements, and verified the performance model correlations, the thermal time constants of the components, and the passive thermal model correlations.

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